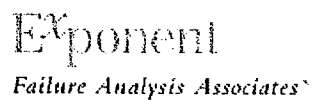


## **EXHIBIT G**



**Investigation of the  
December 20, 2002  
Fire at The  
Marino Carriage House**

Prepared for

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## Executive Summary

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Exponent was retained by Ryan, Coughlin & Betke, LLP to perform an engineering analysis of the fire that occurred on the morning of Friday, December 20, 2002 at the Marino carriage house in Dedham, Massachusetts. A major renovation of the carriage house was nearing completion at the time of the fire. It is alleged that the fire began under the kitchen sink as a result of recently performed soldering work.

Exponent staff and consultants performed inspections of the carriage house and related evidence, and reviewed reports of plaintiff consultants, photographs taken by other investigators, photographs taken by Mr. Marino, deposition testimony, architectural drawings of the carriage house, and other materials produced in this litigation. The opinions and findings in this report were reached to a reasonable degree of scientific and engineering certainty based on information available to date. A summary of the findings and opinions reached in this report is listed below:

1. A region near the south end of the kitchen is a possible area of origin. It is also likely, however, that the fire started in adjacent areas of the building on the first or second floor.
2. The plumber, Mr. Kemp, did not perform soldering in the kitchen on the afternoon before the fire.
3. At the time the fire began, all joints of the water piping were intact, water was turned on in the carriage house, and the water piping under the sink was pressurized.
4. Two soldered joints became disconnected due to the heat of the fire and lowering of the soldering melting temperature due to contact with lead in the leaded-brass components. Other pipe joints with copper-to-copper connections were not subject to this same mechanism.
5. The fire did not originate under the sink or in the wall behind the sink, as alleged by Mr. Klem.

6. The cause of the fire cannot be determined based on information currently available.

If additional information becomes available or additional analysis is performed, I reserve the right to revise these opinions.

## **1 Background**

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Exponent was retained by Ryan, Coughlin & Betke, LLP to perform an engineering analysis of the fire that occurred on the morning of Friday, December 20, 2002 at the Marino carriage house in Dedham, Massachusetts. A major renovation of the carriage house was nearing completion at the time of fire. It is alleged that the fire began under the kitchen sink as a result of recently performed soldering work.

Exponent staff and consultants performed inspections of the carriage house and related evidence on the following dates:

- February 7, 2002 – inspection of carriage house
- February 14, 2002 – inspection of carriage house
- February 26, 2002 – inspection of carriage house
- September 20, 2005 – inspection of evidence
- November 10, 2005 – inspection of evidence
- January 16-18, 2006 – inspection of evidence

In addition to these inspections, as part of my investigation I have reviewed reports of plaintiff consultants, photographs taken by other investigators, photographs taken by Mr. Marino, deposition testimony, architectural drawings of the carriage house, and other materials produced in this litigation. The opinions and findings in this report were reached to a reasonable degree of scientific and engineering certainty based on information available to date. If additional information becomes available or additional analysis is performed, I reserve the right to revise these opinions.

### **1.1 Marino Estate**

The Marino estate in Dedham, Massachusetts consists of several buildings including the main house, carriage house, utility building, and gate house, as shown in Figure 1. At the time of the

fire, the Marino family lived in the main house, a property caretaker Robert Cullinane and his son lived in the gate house, and the utility building contained various utilities for the estate and served as an office for Mr. Cullinane and Kraig Magnussen. Mr. Magnussen was overseeing the renovation of the carriage house, which was approximately 3 weeks from completion at the time of the fire.<sup>1</sup> In the days before the fire, various tradespeople were completing work on the carriage house.

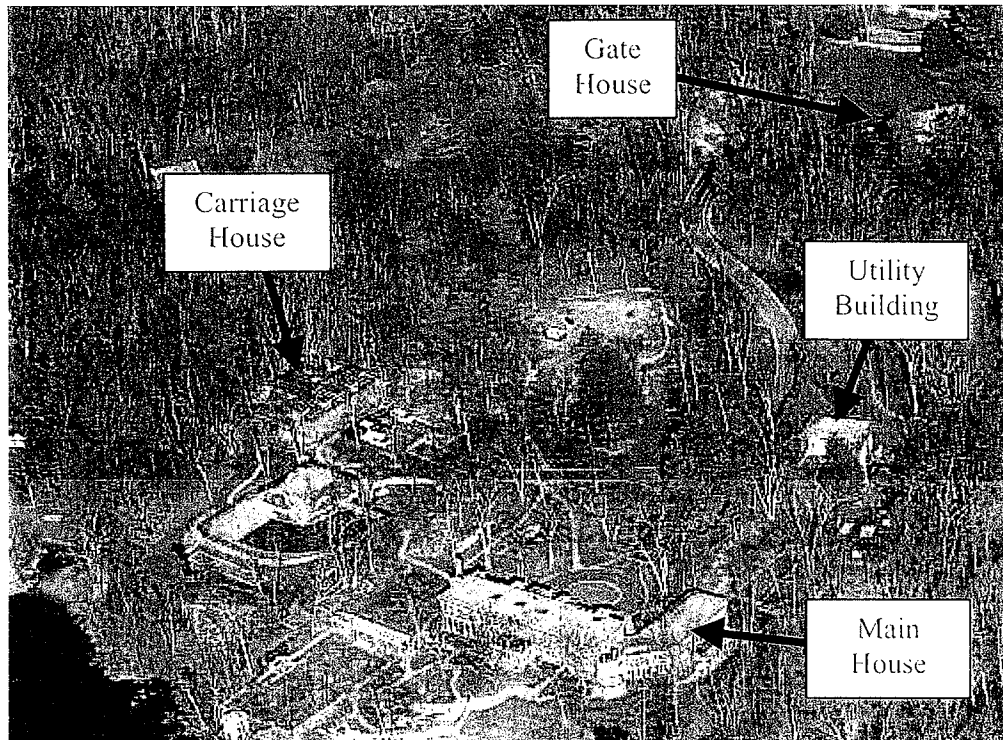


Figure 1: Aerial photograph of Marino complex during renovations to the carriage house

The Carriage House was a two story building with a finished basement and had a brick exterior. The basement contained various utilities, men's and women's cabanas, laundry rooms, a Jacuzzi and sauna. The first floor contained a kitchen, living room, entertainment, exercise and recreation rooms. The second floor contained offices, conference rooms, and a guest bedroom and bathroom. A floor plan of the first floor is shown in Figure 2. The kitchen, where the fire

<sup>1</sup> Deposition of Kraig Magnussen, p. 29.

was alleged to have originated was located in the front right (northeast)<sup>2</sup> corner of the building on the right side of the photograph in Figure 3. All three floors of the building were interconnected via a spiral staircase located near the middle of the building. Additional photographs of the exterior of the carriage house after the fire are shown in Figure 4 through Figure 7.

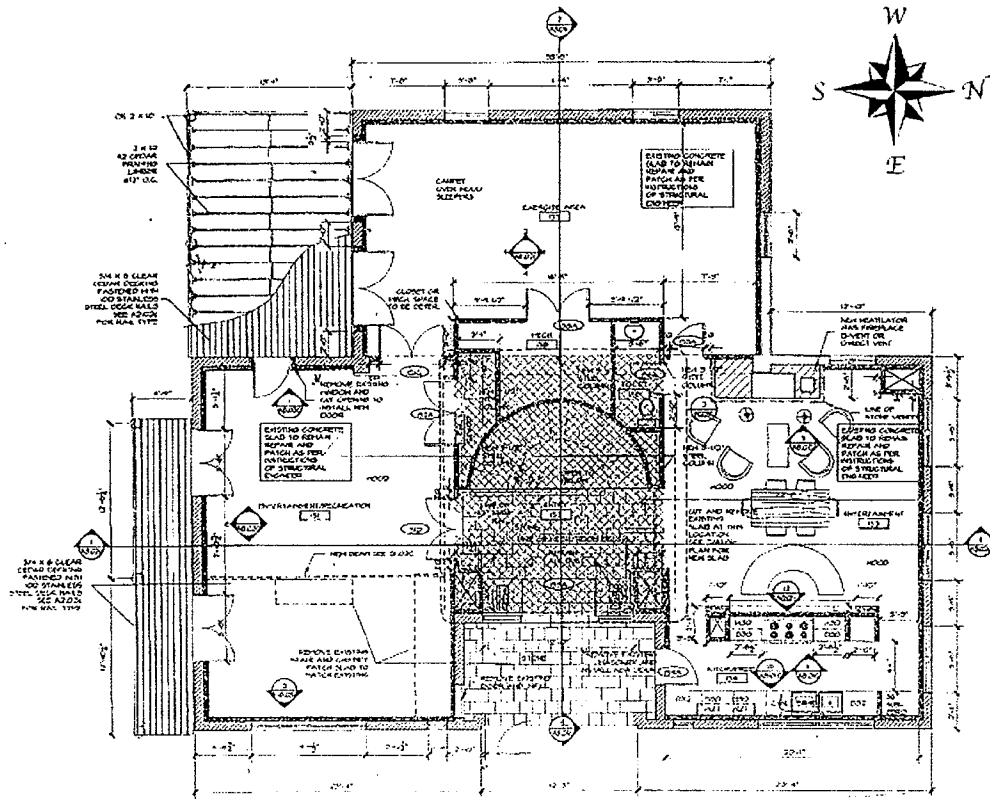


Figure 2: Plan view of first floor of building. The kitchen is located in the bottom right corner of the figure. The north side of the building is to the right of the figure.

<sup>2</sup> The carriage house faces southeast. Consistent with building drawings, in this report the front of the house is referred to as the east side of the house. Some witnesses refer to the front of the house as the south side of the house in depositions.

## 1.2 Detection of Fire

Smoke detection systems were reportedly present in the building but not functional at the time of the fire.<sup>3</sup> On the day of the fire, Brian, the son of the estate's caretaker Mr. Cullinane, came home to the gate house at approximately 1:00 am and did not see lights or fire from the carriage house.<sup>4</sup> Slightly before 2:30 am Mr. Marino reportedly got up to use the restroom in the main house, and when he looked out the kitchen window of the main house he observed flames coming from the roof of the carriage house.<sup>5,6</sup> Mr. Marino first mistakenly dialed 411 while trying to reach 911. He then called Mr. Cullinane, who subsequently reported the fire to the fire department and headed towards the scene.<sup>7,8</sup> The fire incident report indicates that the fire was reported at 2:24 am and that the first firefighting equipment arrived at 2:27 am.<sup>9</sup> The fire was contained at about 5:00 am but not fully extinguished until approximately 5:00 pm that afternoon.<sup>10,11</sup> At some point after his arrival to the fire scene, Mr. Cullinane shut off the gas, water, and electricity to the carriage house at the shut off locations near the utility building.<sup>12</sup> During the fire, Mr. Marino took a series of photographs of the burning carriage house with a disposable camera.<sup>13</sup> Mr. Marino testified that he thought he took the photographs after the fire department arrived, however some photographs appear to have been taken before firemen or firefighting apparatus were present.

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<sup>3</sup> July 29, 2005 report. Thomas J. Klem, p. 3.

<sup>4</sup> Francis M. McGinn, Fire Investigation Summary Report, Case Number 2002-117-2011, p. 1.

<sup>5</sup> Francis M. McGinn, Fire Investigation Summary Report, Case Number 2002-117-2011, p. 2.

<sup>6</sup> Deposition of Roger Marino, pp. 12, 16.

<sup>7</sup> Deposition of Roger Marino, p. 15.

<sup>8</sup> Francis M. McGinn, Fire Investigation Summary Report, Case Number 2002-117-2011, p. 1.

<sup>9</sup> Massachusetts Fire Incident Report, Incident # 23677.

<sup>10</sup> Massachusetts Fire Incident Report, Incident # 23677.

<sup>11</sup> Deposition of Craig Magnussen, p. 121.

<sup>12</sup> Deposition of Robert Cullinane, pp. 47-50.

<sup>13</sup> Deposition of Roger Marino, p. 15.



from the top down. At the end of the fire, the back wall of the kitchen across from the window was almost entirely consumed, as shown in Figure 14.



Figure 14: Post fire view into kitchen window.

Because heat and flames spread up and out, these photos suggest the fire originated on the first floor in a region slightly to the right of (north of) the center of the carriage house, *i.e.* towards the right (north side) of the foyer and towards the left (south side) of the kitchen. The initial photographs, however, show an intense fire located in the second floor. This indicates that the fire may have started on the second floor; with the stairway, foyer, and kitchen being subsequently ignited by drop-down of burning material from the second floor.

## 2.2 Fire Damage to the Carriage House

The basement of the carriage house remained relatively undamaged by fire due to the concrete ceiling/floor between the basement and first floor. Minimal fire damage was present in the basement near the stairwell due to drop-down. Fire damage on the first floor was primarily confined to the right-front (northeast) quarter of the carriage house, with heavy damage to the

foyer, stairway, kitchen and entertainment area behind the kitchen. There was minimal fire damage to the entertainment area to the left (south side) of the staircase and the exercise room in the back of the carriage house. Fire spread throughout most of the second floor, as can be seen by exterior damage visible in photographs shown in Figure 3 through Figure 7. The most severe damage on the second floor was in the front of the carriage house, slightly to the right of (north of) center.

Because of the significant duration of the fire and extensive burning, it is difficult to determine the directionality of the spread of fire through much of the building. In some regions it appears that ceiling joists between the first and second floor were attacked by fire from the bottom up, while in other regions it appears they were attacked from the top down. Similarly, on some of the remaining wood framing on the wall between the kitchen and the entertainment area it is difficult to determine if they were attacked from the side of the kitchen or the side of the entertainment room. However, the most significant fire damage on the first floor is located in the left (south) side of the kitchen and surrounding areas.

## **2.3 Electrical Evidence of Area of Origin**

Mr. Andrew Diamond, an electrical engineer, inspected the carriage house and all electrical evidence retained from the fire. As described in his report, he found that every circuit breaker that supplied electricity to the kitchen area and that was energized at the time of the fire had tripped. Additionally, he found that circuit breakers supplying electricity throughout the carriage house tripped during the fire. A total of 41 circuit breakers supplying power to the inside and outside of the carriage house were found in the tripped position. The circuit breakers may have tripped prior to the fire as a result of electrical activity that ignited the fire.

Alternatively, energized wire that is attacked by fire will typically cause electrical activity that will trip a circuit breaker as the wiring insulation becomes compromised. From this electrical evidence it is not possible to determine an area of origin nor a cause. The tripping of circuits throughout the carriage house does provide an indication of the extent of fire spread before Mr. Cullinane turned off power to the carriage house.

## **2.4 Summary of Area of Origin**

Based on the early photographs of the fire and the fire damage observed to the carriage house, it is possible that the fire originated near the left (south) end of the kitchen or adjacent areas of adjoining rooms (i.e., foyer, entertainment room). Due to the extensive damage to the building however, it is not possible to rule out that the fire began above this area on the second floor, and subsequently spread to the kitchen by burning materials dropping down.

### 3 Kitchen Sink as Area of Origin

In his July 29, 2005 report, Mr. Thomas Klem alleges that the fire began underneath the kitchen sink which was located below the center of the kitchen window on the front (east) wall of the carriage house. The portion of Figure 2 corresponding to the kitchen is enlarged in Figure 15 to show this area in greater detail.

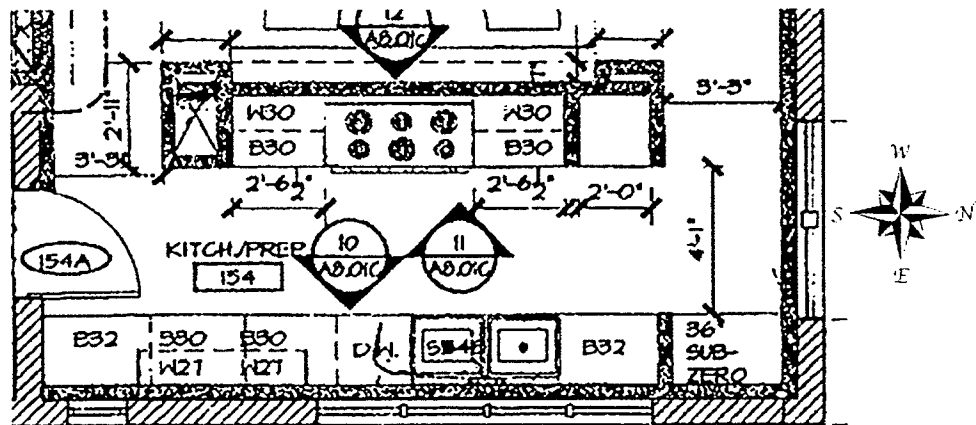


Figure 15: Enlargement of kitchen area of first floor from bottom right hand corner of Figure 2. Kitchen sink is centered in front of the large kitchen window located on the east wall of the carriage house. The installed kitchen sink was a single basin sink, contrary to what is shown in the drawing.

The kitchen sink was installed below the large window located on the north portion of the east wall of the building (right side of Figure 3 and photographs taken by Mr. Marino). Additional kitchen windows visible in photographs taken by Mr. Marino are a small window on the left front wall of the kitchen and a window on the right wall (north side) of the kitchen in Figure 15. Two photographs of the kitchen sink below the window shown in Figure 16 and Figure 17 were taken from the interior of the kitchen on the day of fire.

### 3.1 Fire Damage to Region around Kitchen Sink

The lack of fire damage to the kitchen sink cabinet and front kitchen wall near the sink was remarkable. Throughout the rest of the kitchen, cabinets and the wooden interior wall were consumed almost all of the way down to the kitchen floor. The dishwasher next to the sink was heavily damaged, including its interior. Fire damage to the region below the kitchen sink is not consistent with the kitchen sink being the area of origin. The area below the kitchen sink was the least damaged area of the kitchen after the fire, and fire damage in the region of the kitchen sink was consistent with the sink cabinet being attacked from the outside, rather than a fire spreading from the inside of the cabinet as alleged by Mr. Klem.

As shown in Figure 16 and Figure 17, fire damage extends to the floor on either side of the kitchen sink and dishwasher while the kitchen sink cabinet remained largely intact from the floor up to the bottom of the windowsill. Wooden interior walls, constructed of wooden stud bays filled with fiberglass insulation and covered by a plastic vapor barrier and plywood on the interior, were constructed against the brick walls. They were almost completely consumed everywhere except for the region behind the kitchen sink. Cabinets to the south of the kitchen sink (to the right when looking out the front window) and the front wall were burned down to the ground as shown even more clearly in Figure 18 and Figure 19, which are photographs taken as debris and evidence were removed from the kitchen. Mr. Klem also identified the regions of burn damage at low elevations or low burn to the right of the kitchen sink and dishwasher (shown in Figure 18) as the area of the lowest elevation of burning in the kitchen.<sup>16</sup> This region of the kitchen is located underneath the area of the most severe burning observed in the photographs taken by Mr. Marino (located at the left of his photographs or south end of the kitchen).

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<sup>16</sup> July 29, 2005 report, Thomas J. Klem, p. 8.

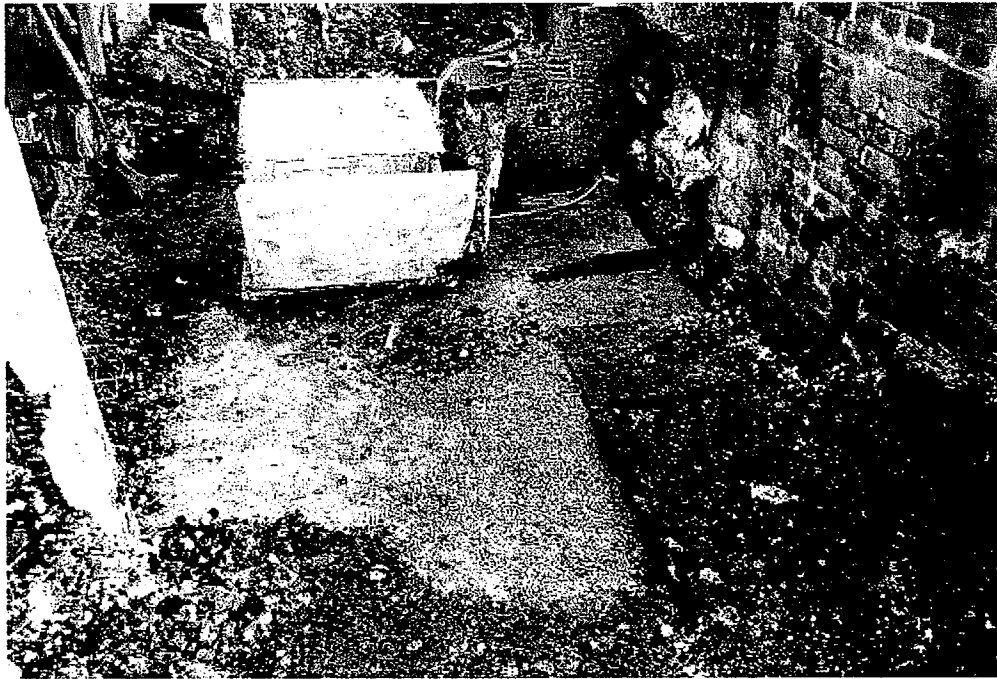


Figure 18: Photograph taken during the removal of the dishwasher from kitchen area. Cabinets in the bottom right corner of the photograph are consumed to the floor level while the sink cabinets remain largely intact up to bottom of window.

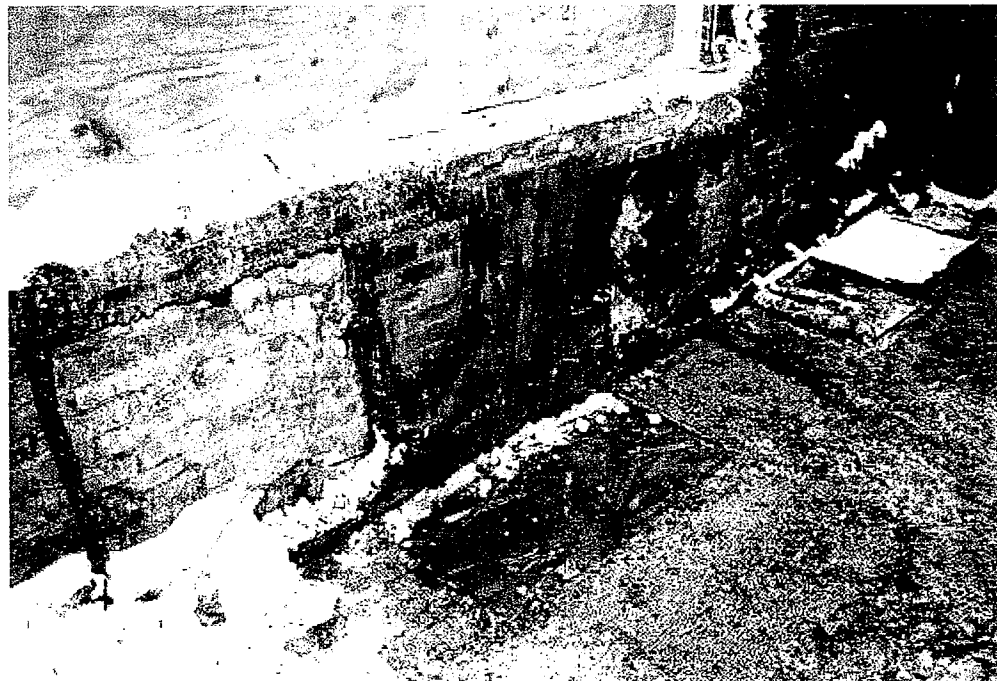


Figure 19: Photograph taken after removal of the sink cabinet and dishwasher from the kitchen area. Cabinets in the top right corner of photograph are consumed to the floor level while the sink cabinets remain largely intact up to the bottom of the window.

The wooden joist above the kitchen that formed the ceiling/floor between the first and second floors were completely consumed above most of the kitchen. In sharp contrast, two joists and a section of flooring remained intact directly above the center of the window above the kitchen sink as shown in Figure 20 and Figure 21. Such a lack of burn damage in the area around and above the kitchen sink would not be expected if it were indeed the area of origin of the fire.



Figure 20: Photograph of ceiling joists and flooring remaining above center of front (east) kitchen window and kitchen sink. The photograph is taken looking east.





Figure 21: Photograph of ceiling joists and flooring remaining above center of kitchen window and kitchen sink. The front (east) kitchen window is to the right of the photograph. The photograph is taken facing north.

### 3.2 Relative Damage to Interior and Exterior of Kitchen Sink Cabinet

Charring to the kitchen sink cabinet indicates that it was attacked by fire from the exterior rather than the interior. This is consistent with the cabinet being attacked by a fire that started somewhere else and later spread to the cabinet, rather than a fire originating inside the cabinet. A photograph of the kitchen sink cabinet, taken after the kitchen sink was removed at the carriage house, is shown in Figure 22. The kitchen sink cabinet was mounted against plywood on the front wall of the carriage house. Both the cabinet and the plywood on the wall show evidence of being attacked from the sides rather than a fire spreading from within the cabinet outwards. This was the only portion of plywood and cabinet on the front wall of the kitchen that remained intact after the fire.



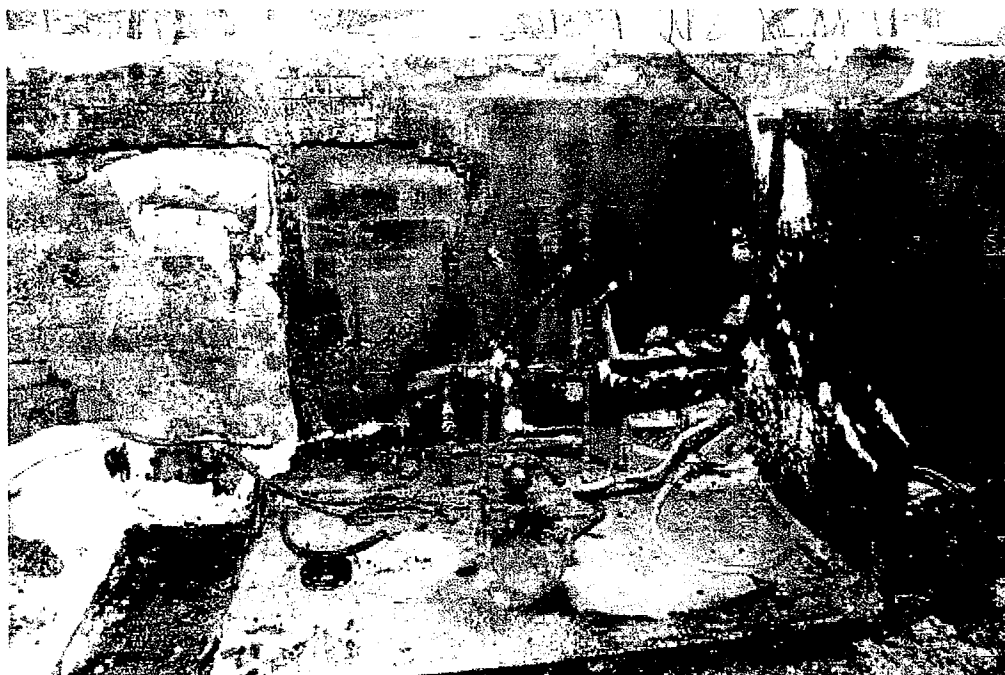


Figure 22: Photograph of kitchen sink cabinet and water piping after removal of kitchen sink.

Additional photographs taken of the cabinets and wall after they were removed from the kitchen further demonstrate that they were attacked by fire from the outside. Two photographs taken from the north and south sides (left and right sides when looking out the front kitchen window) of the kitchen cabinet are shown in Figure 23. In each photo more significant fire damage is observed to both the left and the right of the cabinet than within the cabinet itself. As you move from the sink to either side, a greater extent of wood is consumed and deeper charring is present. This is further demonstrated in Figure 24, showing two photographs taken from either side of the wood cabinet wall between the sink and the dishwasher. Even though the dishwasher partially shielded the wood from fire, it has more significant charring on the outside of the cabinet (adjacent to the dishwasher) than the inside of the cabinet.



Figure 23: Photographs of sink cabinet looking from the left and the right. Fire damage to the wall structure and the cabinet is more severe outside of the cabinet than within the cabinet.



Figure 24: Photographs of the sink cabinet wall that was between the sink and the dishwasher. The photograph on the left is the inside of the cabinet (away from dishwasher) and the photograph on the right is the outside of the cabinet (facing dishwasher). A greater amount of char is visible on the outside of the cabinet indicating it was attacked by fire from the outside.

The floor of the kitchen sink cabinet is virtually undamaged as shown in Figure 25. Some fire damage is present in the right front of the cabinet, consistent with the cabinet being attacked from the exterior. A section of gray polymeric material is melted to the floor of the cabinet, between where the copper water pipes penetrate the bottom of the cabinet. It is consistent with sound deadening material that was applied to the bottom of the metal sink and fell to the floor of the cabinet as the sink was heated from above. Some discoloration or charring is visible to the floor of the cabinet near the back. Other investigators imply that this discoloration was caused by dripping solder. As can be seen in later photographs this region of cabinet floor is directly below the drain opening on the sink. Because the garbage disposal and drain had not yet been attached to the sink, burning material from above was able to drop down through the sink drain hole and cause this damage.

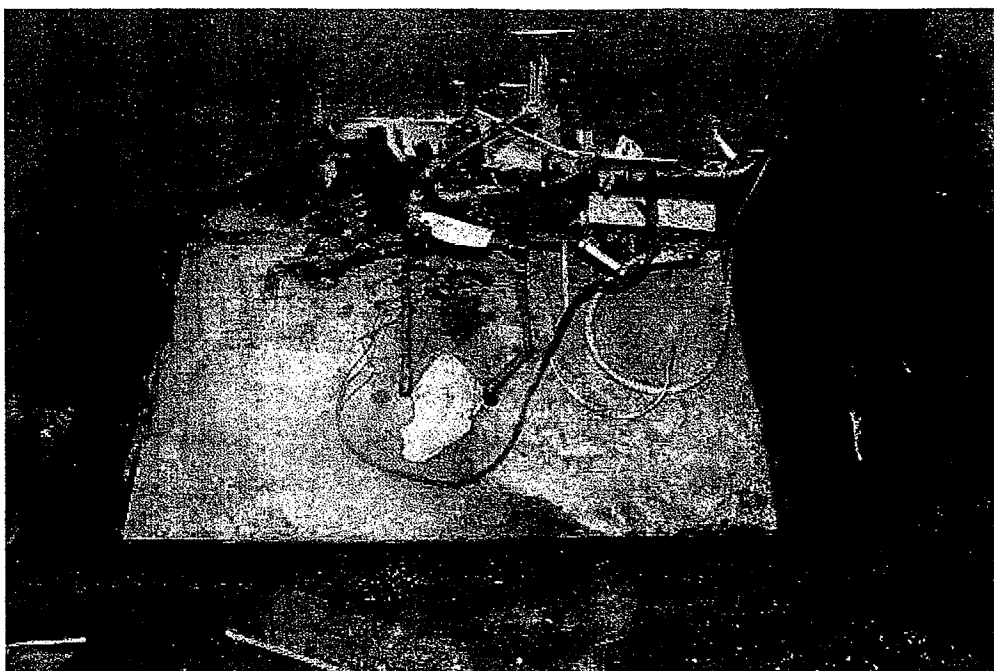


Figure 25: Floor of kitchen sink cabinet.

### 3.3 Fire Damage to Interior of Kitchen Wall

In his report Mr. Klem indicates that the fire was caused by a plumber's torch which had ignited materials within the wall. This initial fire supposedly smoldered for approximately 9 hours within void spaces in the wall before spreading through these voids to the interior of the kitchen and the second floor.<sup>17</sup> Fire damage to the interior of the wall is not consistent with this theory. As is discussed in more detail below, fire damage to the wall is consistent with the wall being attacked from the interior of the room to the south (right hand side when looking out the front window) of the sink cabinet and dishwasher, and not from a fire that smoldered within the wall for several hours.

In Figure 26 and Figure 27 photographs of the front kitchen wall that remained near the sink are shown with both the sink cabinet in place and removed. Wood studs and plywood all show signs of being attacked by a fire that started within the room and spread outward to the wall. Plywood that was covering studs to the left and right of the sink is consumed, and the surfaces

### 3.5 Summary of Damage to Kitchen Sink Cabinet and Wall

There is no evidence of a fire smoldering for hours in the wall behind the kitchen and then spreading fire to the rest of the carriage house. The minimal damage to the plastic vapor barrier contradicts Mr. Klem's theory that it was ignited and able to spread fire throughout the wall.<sup>19</sup> Had a fire smoldered for hours on the interior of the wall, significant heat damage would be expected throughout the interior of the wall, including wood studs, the polymeric vapor barrier and insulation. Electrical evidence also indicates that the region near the kitchen sink cabinet was attacked by fire after fire had attacked other areas of the carriage house. In summary, the damage to the kitchen sink and wall behind it is consistent with it being attacked by an external fire rather than it being the origin of the fire.

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<sup>19</sup> July 29, 2005 report, Thomas J. Klem, p. 17-18.

## 4 Soldering as the Ignition Source

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As described above, Mr. Klem determined that the area of origin was under the kitchen sink. He was not able to identify an ignition source in this area, and by a process of elimination hypothesized that Mr. Kemp must have been using a torch on the afternoon of Thursday December 19, which caused materials in the wall to smolder overnight before igniting the fire in the carriage house. NFPA 921 cautions against the use of the process of elimination unless the area of origin of the fire is clearly defined:<sup>20</sup>

*Any determination of fire cause should be based on evidence rather than on the absence of evidence; however, when the origin of a fire is clearly defined, it is occasionally possible to make a credible determination regarding the cause of the fire, even when there is no physical evidence of the ignition source available. This finding may be accomplished through the credible elimination of all other potential ignition sources, provided that the remaining ignition source is consistent with all known facts.*

It is my opinion that the origin of the fire is not clearly defined to the area under the kitchen sink, but that it is clear that the fire did not start in that area. This makes use of the process of elimination inappropriate. In addition, as described below, this alleged ignition source is not consistent with all known facts. In hypothesizing that Mr. Kemp performed soldering on the afternoon before the fire, Mr. Klem assumes Mr. Kemp lied during interviews and his deposition, that no one turned off the water to the carriage house during the fire, and that the water must have been off at the time of the fire. Most, if not all, of these assumptions have been refuted based on deposition testimony that occurred after he released his report.

### 4.1 Removed Section of Cold Water Piping

Part of the basis for Mr. Klem believing that Mr. Kemp was soldering on the afternoon before the fire, Thursday, December 19, is that after the fire a section of cold water piping under the

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<sup>20</sup> Section 18.2.1, NFPA 921 *Guide for Fire and Explosion Investigations*, 2004.



sink was disconnected from the remainder of the pipe. The section of disconnected pipe with a shut-off valve is shown in Figure 32 and Figure 33. To disconnect this section of pipe two soldered joints had to have become disconnected. Mr. Klem concludes that this section of pipe was removed by Mr. Kemp the afternoon before the fire. Mr. Kemp testified that he noticed late in the afternoon before the fire that he would have to move some piping because it would interfere with installation of the garbage disposal but that he decided to wait to do that until the next day and that he did not rotate or move any piping.<sup>21</sup>



Figure 32: Photograph of valve and section of pipe that became disconnected from cold water piping.

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<sup>21</sup> Deposition of Alfred Kemp, pp. 73-76.

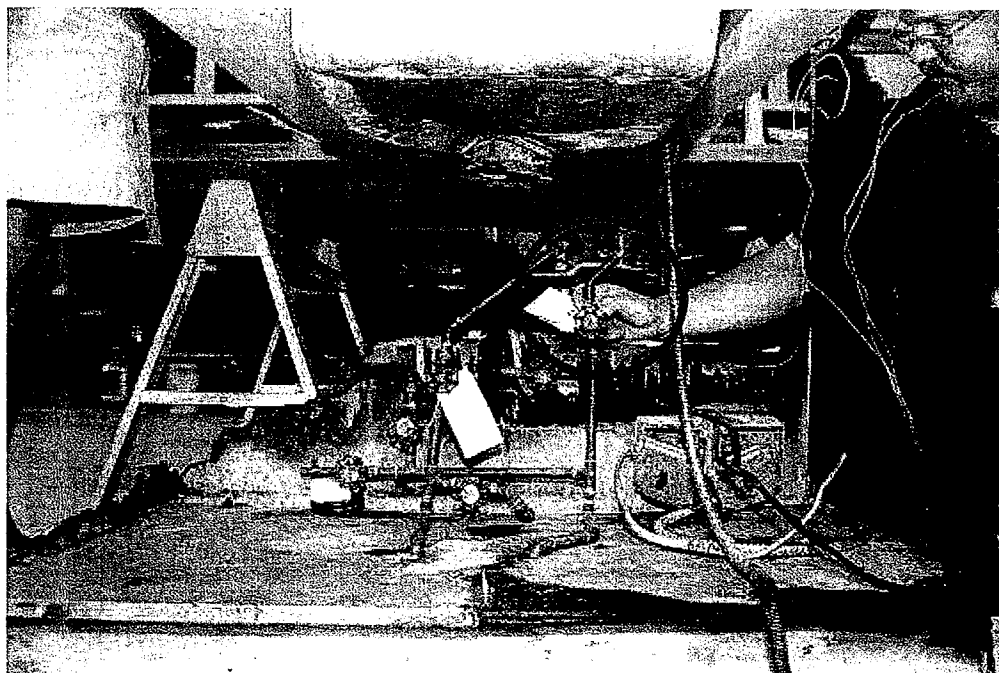


Figure 33: Photograph of disconnected section of valve being held in its original location.

There is a significant distance between where Mr. Kemp is alleged to have used a torch to take apart soldered joints and any portions of the sink cabinet with significant fire damage. As shown in Figure 33 and Figure 34, the location of the portion of pipe that Mr. Kemp allegedly heated with a torch is over 1 foot away from any region of the wall penetration that is significantly burned. Additionally, as shown in Figure 35, exposed plastic vapor barrier remains intact over the portion of this opening that is closest to the water pipe. It is unlikely that an experienced plumber like Mr. Kemp would inadvertently burn portions of the cabinet over 1 foot away from where he was allegedly using the torch.



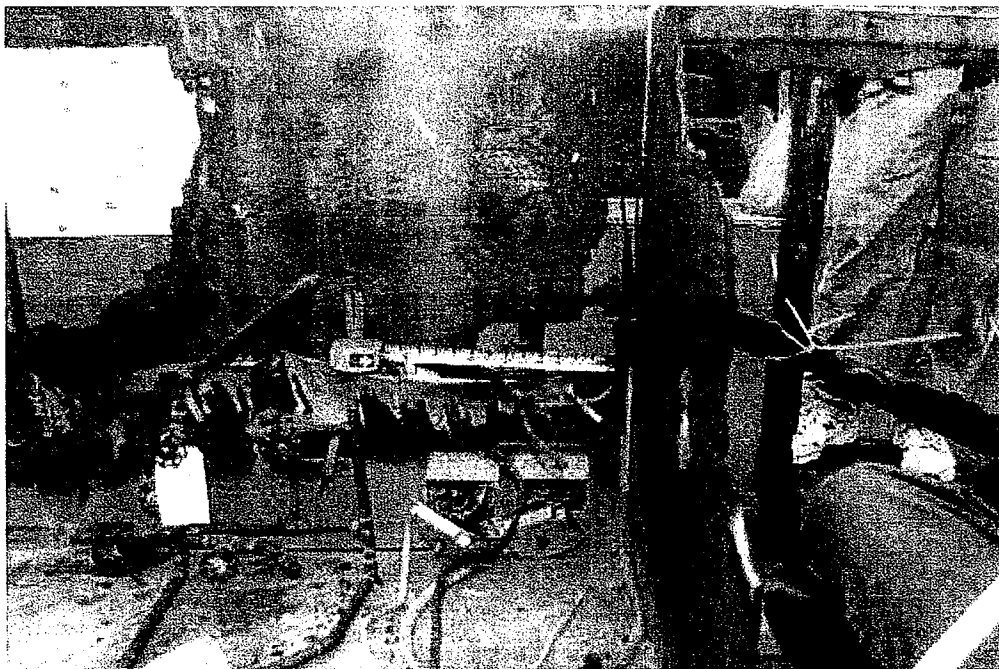


Figure 34: Photograph showing distance of water pipe from penetration in wall.

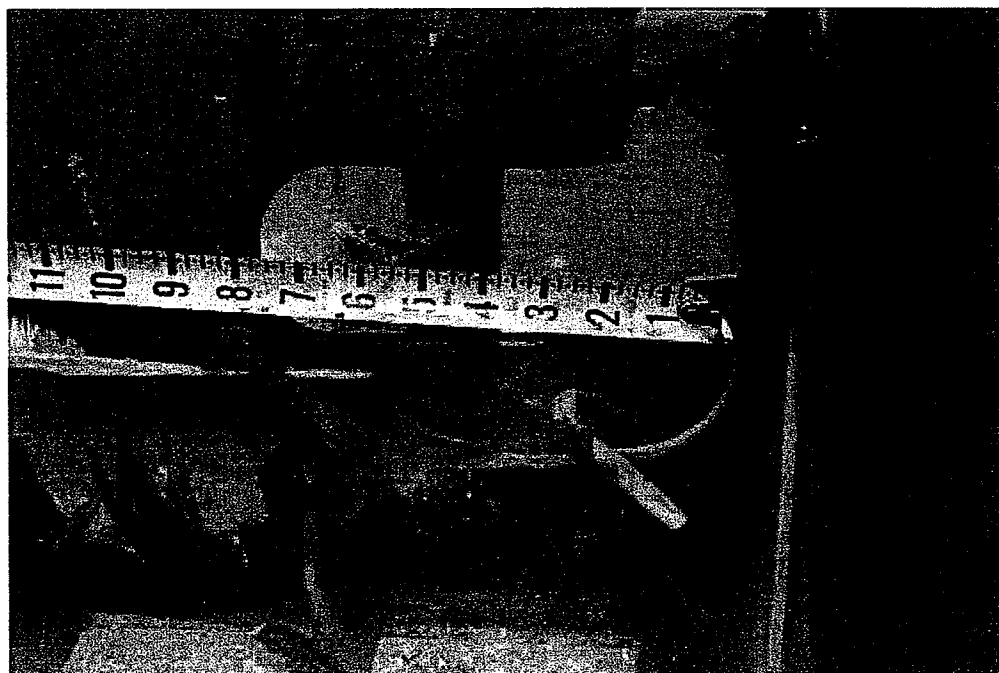


Figure 35: Photograph showing penetration in wall.

## 4.2 Testimony of Witnesses about Use of Torch

Consistent with his earlier interviews with the state fire marshal, Mr. Kemp testified during deposition that he did not use his torch in the carriage house on the day before the fire, Thursday, December 19.<sup>22</sup> He testified that he last performed soldering in the carriage house on Wednesday, December 18 and that he completed that soldering before he turned the water back on in the carriage house, at approximately 12:30 or 1:00 pm.<sup>23</sup> This testimony is further supported by a construction log book maintained by Mr. Magnussen, which indicates that on Wednesday, December 18, 2002 two men from Sandborg plumbing shut down the water at 256 (the carriage house) and sweat stops in the basement, 1<sup>st</sup>, and 2<sup>nd</sup> floors. Mr. Magnussen testified that he remembers that these plumbers were Al Kemp and an assistant.<sup>24</sup> Sweating stops refers to soldering stops or shut-off valves in place of caps that were installed on the rough plumbing in the carriage house.<sup>25</sup>

On the day of the 19<sup>th</sup>, Mr. Kemp began working in the kitchen at about 1:30 pm and worked until about 3:30 pm, at which time he began cleaning up and left the site at 4:00 pm.<sup>26,27</sup> Several people were present that afternoon and no one observed Mr. Kemp using a torch, including Mr. Magnussen, who was installing a hood over the kitchen stove and helped Mr. Kemp clean up at the end of the day.<sup>28</sup>

## 4.3 Status of Water at Time of Fire

Messrs. Klem and MacLaughlin both state that in order for Mr. Kemp to remove the shutoff valve with a torch, water would have had to be shut off to the kitchen sink.<sup>29</sup> If the valve were removed and the water was not shut off to the carriage house, water would have continued to

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<sup>22</sup> Deposition of Alfred Kemp, p. 65.

<sup>23</sup> Deposition of Alfred Kemp, pp. 59-63.

<sup>24</sup> Deposition of Kraig Magnussen, p. 93.

<sup>25</sup> Deposition of Kraig Magnussen, pp. 94-97.

<sup>26</sup> Deposition of Alfred Kemp, pp. 41-43.

<sup>27</sup> Francis M. McGinn, Fire Investigation Summary Report, Case Number 2002-117-2011, pp. 2, 3.

<sup>28</sup> Deposition of Kraig Magnussen, pp. 111, 112, 143, 165, 166.

<sup>29</sup> July 26, 2005 Report of Lester S. MacLaughlin, p. 2.

flow from the open piping.<sup>30</sup> So unless the water had been turned off the afternoon before the fire, Mr. Kemp could not have removed the piping section and valve. All available evidence is that the water was on the afternoon before the fire, and at the time the fire started.

Mr. Magnussen didn't recall specifically if the water was turned back on Wednesday, December 18, but testified that as a normal practice the water would have been turned back on to test the solder-joints of the stops or shut-off valves. Additionally, he stated that when setting toilets, which according to Mr. Magnussen's log was done on both the Wednesday, December 18 and Thursday, December 19, the toilets would need to be filled with water.<sup>31</sup> Late in the afternoon the day before the fire Steve Driscoll stopped by the carriage house to visit friends that were working there and to see the carriage house.<sup>32</sup> Mr. Driscoll said he visited the carriage house at the end of his work day, which he estimated as approximately 4:00 to 4:30 pm, and when he arrived he saw Mr. Kemp hooking up the sink.<sup>33</sup> Mr. Kemp recalls Mr. Driscoll arriving somewhat earlier in the afternoon, between roughly 2:00 and 3:00pm.<sup>34</sup> Mr. Driscoll is a plumber and as he walked around the carriage house and examined the plumbing, he checked sink faucets in various bathrooms to see whether or not hot and cold water had been connected properly and observed that the water was running in the carriage house.<sup>35</sup>

In his report Mr. Klem stated that no one reported turning off the water to the carriage house after the fire or observing water leaking in the kitchen area due to the shut-off valve coming off piping under the sink. This fact, he argues, would indicate that water was off at the time of the fire.<sup>36</sup> Contrary to this assumption, however, Mr. Cullinane and Mr. Magnussen testified at their depositions that Mr. Cullinane shut off the gas, electricity, and water service to the carriage house at the utility building after arriving at the scene of the fire.<sup>37,38</sup> This explains why firefighters did not observe water running in the kitchen after the fire was extinguished. Mr.

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<sup>30</sup> Deposition of Alfred Kemp, p. 86.

<sup>31</sup> Deposition of Kraig Magnussen, pp. 101, 102, 110, 111.

<sup>32</sup> Deposition of Stephen Driscoll, pp. 6, 7.

<sup>33</sup> Deposition of Stephen Driscoll, pp. 8, 13, 34.

<sup>34</sup> Deposition of Alfred Kemp, p. 69.

<sup>35</sup> Deposition of Stephen Driscoll, pp. 13-15, 31, 32.

<sup>36</sup> July 29, 2005 report, Thomas J. Klem, p. 14.

<sup>37</sup> Deposition of Robert Cullinane, pp. 49-51.

<sup>38</sup> Deposition of Kraig Magnussen, p. 128.

Sandborg confirmed that someone had turned off the water to the carriage house at the utility building. He testified that he returned to the carriage house days after the fire and found the main water shut-off valve inside the carriage house in the on position and the valve at the utility building in the off position.<sup>39</sup> Had Mr. Kemp shut off water to the carriage house, he would have used the valve in the basement, which was in the open position.

#### **4.4 Metallurgical Examination of Piping Joints**

The report by Mr. Klem cites the disconnected pipe joints found after the fire as proof that Mr. Kemp had been soldering the afternoon prior to the fire. It is also reasoned in this report that the fire alone would not have been able to melt the solder in two of the joints without affecting the others. Dr. Quinn Horn performed a metallurgical examination of the two piping joints that became disconnected. He describes in his report that the solder remaining on the joints is not consistent with the joints being heated by a torch and removed by a plumber. Most of the solder on the joints does not appear to have melted after the joints were originally joined. He observed that the two joints that became disconnected consisted of leaded-brass components connected to copper piping. His metallurgical examination revealed that a thin layer of the solder near the surface of the leaded-brass components melted, allowing the joints to separate under load. Lead in the leaded-brass components lowered the melting point of the solder near the surface by 60 to 80° F to approximately 360°F. This explains why these joints separated, while other copper-to-copper joints remained intact.

#### **4.5 Disconnection of Joints by Fire**

Because a drain was not installed in the sink, Mr. Kemp indicated that he would not have bled air from the water lines going to the sink. Thus, at the beginning of the fire the water lines under the sink would have been pressurized because the water was turned on but filled with air rather than water. The ignition of portions of the wood of the kitchen sink cabinet nearby indicates that temperatures in the region of the disconnected water pipe were above 360 °F. As the solder melted near the copper-to-leaded-brass interfaces, the joints would have come apart

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<sup>39</sup> Deposition of Martin Sandborg, pp. 63-68.

from internal pressurization of the pipes or mechanical loads placed on the joints as components moved during the fire.

If the water valve had separated from the pipe before Mr. Cullinane turned off the water, water would have flowed from the pipe under the sink until the water was turned off. If the water valve separated from the pipe after Mr. Cullinane turned off the water, pressure remaining in the pipe would have blown the valve off and some water may have come out of the line until the water system in the carriage house became depressurized. Due to lack of damage to the kitchen sink cabinet relative to all other wood materials in the kitchen, it seems likely that water did flow from the pipe for some period of time. This would have acted much like a fire sprinkler in a building. As the fire began attacking the kitchen cabinet around the valve, the valve opened releasing water, which protected the region around the sink from fire until the water was shut off by Mr. Cullinane.

Mr. MacLaughlin stated that soot was present inside the piping, which would indicate that the piping was removed before the fire.<sup>40</sup> Soot and other debris could have entered these connections after the joints became disconnected and Mr. Cullinane turned off the water in the carriage house. Additionally, components were exposed to the elements in the carriage house for weeks after the fire.

## **4.6 Summary of Soldering as the Ignition Source**

As described above, there is no evidence that Mr. Kemp was soldering on the afternoon before the fire, and there is significant evidence that water to the carriage house remained turned on from the afternoon of Wednesday, December 18 until Mr. Cullinane turned off the water during the fire, the morning of Friday, December 20. The soldered joints on a portion of piping became disconnected due to heating from the fire and a lowering of the melting point of the solder near the surface of leaded-brass fittings. Water that exited the piping after the valve was displaced likely minimized the fire damage to the sink cabinet as it was exposed to the fire.

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<sup>40</sup> July 26, 2005 Report of Lester S. MacLaughlin, pp. 3-4.

## 5 Conclusions

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The opinions and findings in this report were reached to a reasonable degree of scientific and engineering certainty based on information available to date. A summary of the findings and opinions reached in this report is listed below:

1. A region near the south end of the kitchen is a possible area of origin. It is also likely, however, that the fire started in adjacent areas of the building on the first or second floor.
2. The plumber, Mr. Kemp, did not perform soldering in the kitchen on the afternoon before the fire.
3. At the time the fire began, all joints of the water piping were intact, water was turned on in the carriage house, and the water piping under the sink was pressurized.
4. Two soldered joints became disconnected due to the heat of the fire and lowering of the soldering melting temperature due to contact with lead in the leaded-brass components. Other pipe joints with copper-to-copper connections were not subject to this same mechanism.
5. The fire did not originate under the sink or in the wall behind the sink, as alleged by Mr. Klem.
6. The cause of the fire cannot be determined based on information currently available.

If additional information becomes available or additional analysis is performed, I reserve the right to revise these opinions.